



{In Archive} Fw: my analysis of drinking water PAG
Stuart Walker to: David Huber

03/04/2010 08:11 PM

From: Stuart Walker/DC/USEPA/US
To: David Huber/DC/USEPA/US@EPA,

Archive: This message is being viewed in an archive.

My 123 analysis scanned without all the extra pages.



PAGs_vs_Risk_vs_MCL_123_Comparison.pdf

----- Forwarded by Stuart Walker/DC/USEPA/US on 03/04/2010 08:06 PM -----

From: Stuart Walker/DC/USEPA/US
To: David Huber/DC/USEPA/US@EPA
Date: 03/04/2010 06:57 PM
Subject: Fw: my analysis of drinking water PAG

scanned in copy of my Lotus 123 files

[attachment "[Untitled].pdf" deleted by Stuart Walker/DC/USEPA/US]

----- Forwarded by Stuart Walker/DC/USEPA/US on 03/04/2010 06:55 PM -----

From: Stuart Walker/DC/USEPA/US
To: David Huber/DC/USEPA/US@EPA
Date: 03/04/2010 06:41 PM
Subject: my analysis of drinking water PAG

----- Forwarded by Stuart Walker/DC/USEPA/US on 03/04/2010 06:40 PM -----

From: Stuart Walker/DC/USEPA/US
To: Sara DeCair/DC/USEPA/US@EPA
Cc: Doug Ammon/DC/USEPA/US@EPA, Colby Stanton/DC/USEPA/US@EPA, Elizabeth Southerland/DC/USEPA/US@EPA, Juan Reyes/DC/USEPA/US@EPA
Date: 05/15/2007 06:04 PM
Subject: Re: ACTION REQ'D: Five-week review of PAG Manual

Hi Sara,

Thanks for providing us an opportunity to review the latest draft of the ORIA PAGs. OSRTI does not have any showstoppers. We request that you let us review a ~~redline/strikeout~~ version of the next draft after you incorporate comments from the workgroup.

Since, this is the first draft of the ORIA PAG to include concentrations for the drinking water and food interdiction PAGs, we are submitting revised substantive comments on both those PAGs from our comments on the last draft. Our comments on both the drinking water and food interdiction PAGs include a comparison of the PAG concentrations to risk based concentrations, and in the case of the drinking water PAGs, MCLs. These comparisons are similar to the comments I sent Ed Tupin 3-4-2004 on an early draft of the water PAGs.

[attachment "OSRTI comment on ORIA PAGsApril2007v1.doc" deleted by Stuart Walker/DC/USEPA/US]

Below is further explanation of the analysis discussed in the comments on the water and food PAGs.

Water PAGs

Chronic effects

I put together 3 Lotus 123 Tables comparing ORIA's PAG concentrations to MCLs and concentrations corresponding to a 1×10^{-4} cancer risk. I used MCLs and 10^{-4} since these are measures EPA utilizes when making decisions about providing bottled water during emergencies involving class A carcinogens. I noticed that a number of the ORIA PAG concentrations are thousands of times higher than the MCLs or 1×10^{-4} (a few are over a hundred thousand times higher). This is not evident without looking at the concentrations since the MCL for most radionuclides is 4 mrem/yr and the PAG is 500 mrem/yr. However, I understand that different science may have something to do with it since the MCL is based on ICRP 2 methodology and the PAG is ICRP 60/72 methodology, however the 1×10^{-4} risk based concentrations are also based on ICRP 60/72.

Here is an explanation of the comparison tables I put together on the water PAGs and the 3 tables themselves.

[attachment "2007ExplainCompareTables.pdf" deleted by Stuart Walker/DC/USEPA/US] [attachment "2007CompareTable_byRisk.123" deleted by Stuart Walker/DC/USEPA/US] [attachment "2007CompareTable_byMCL.123" deleted by Stuart Walker/DC/USEPA/US] [attachment "2007CompareTable_byRad.123" deleted by Stuart Walker/DC/USEPA/US]

Subchronic effects

It also appears that drinking water at the PAG concentrations for Te-129 and Te-127 may lead to subchronic (acute) effects acute following exposures of a day or a week. In a population, one should see some express of acute effects (not deaths) above 0.25 Gy (25 rad) - that is, vomiting, fever etc. The Te-129 absorbed dose at 1 week was 1.8 Gy (180 rad) for 14 L intake. For these two radionuclides, an acute radiation syndrome (ARS) involving the GI-tract is indicated. Acute dose coefficients for a 30 d period were calculated for the adult using the AcutDose. This analysis focused only on the 16 radionuclides where drinking water at the PAG concentration for 1 week or less would exceed the amount of radioactivity received from drinking a 1×10^{-4} cancer risk level assuming 70 years of exposure.

Food PAGs

I also put together 3 Lotus 123 Tables comparing ORIA's food PAG concentrations that were adopted from FDA to concentrations corresponding to a 1×10^{-4} cancer risk. I used 10^{-4} since the food interdiction situation is somewhat analogous to the decision of when to provide drinking water. I noticed that some of the ORIA PAG concentrations are hundreds, even thousands of times higher than the MCLs or 1×10^{-4} .

Here is an explanation of the comparison tables I put together on the food PAGs and the 3 tables themselves.

[attachment "2007ExplainCompareFOODTables.pdf" deleted by Stuart Walker/DC/USEPA/US]
[attachment "2007CompareFoodTable_convertPRG.123" deleted by Stuart Walker/DC/USEPA/US]
[attachment "2007CompareFoodTable.123" deleted by Stuart Walker/DC/USEPA/US] [attachment "2007CompareFoodTable_byRad.123" deleted by Stuart Walker/DC/USEPA/US]

Sara DeCair/DC/USEPA/US

Sara DeCair/DC/USEPA/US

04/10/2007 10:26 AM

To Andrew.Wallo@eh.doe.gov, cmw6@cdc.gov, cym3@cdc.gov, Kenneth.Wierman@dhs.gov, man@cdrh.fda.gov, pxm@nrc.gov, paul.nelson@dtra.mil, pxs@cdrh.fda.gov, stanton.colby@epa.gov, Sara DeCair/DC/USEPA/US@EPA, stephen.domotor@eh.doe.gov, sam2@nrc.gov, Dan.Wilcox@dhs.gov, Vanessa.Quinn@dhs.gov, william.cunningham@nist.gov, walker.stuart@epa.gov, ammon.doug@epa.gov, schumann.jean@epa.gov, Ferris.John@dol.gov, druedy@endyna.com, itasker@endyna.com, siddhanti@endyna.com,

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cc Mike Boyd/DC/USEPA/US@EPA, Neal Nelson/DC/USEPA/US@EPA, Lowell Ralston/DC/USEPA/US@EPA, Rick Poeton/R10/USEPA/US@EPA, boyd.wesley@epa.gov
Subject ACTION REQ'D: Five-week review of PAG Manual

PAGs Reviewers;

It is time for the final federal review, via FRPCC, of the PAG Manual prior to going into the Federal Register for public comment! This is a SHOWSTOPPERS ONLY review and we are asking for you to obtain your agency or department's (or your AA-ship's within EPA) buy-in on this Manual so we can release it. The five weeks start on April 10th and end on May 15th. Your showstopper comments are due no later than May 15th.

A showstopper is defined as a statement or concept that your agency or department sees as so problematic that we cannot release the Manual for public comment. Since this is the last of several rounds of review, we hope there will not be any such issues. Note that I will be checking in with you over the next few weeks to check on your progress and to see if you have any questions or potential showstoppers.

After this review and our incorporation of any final changes, I will submit the final draft Manual to my management in the Office of Air and Radiation along with the final draft FR Notice of Availability for approval. We plan to issue the FR Notice in June and provide a 60-day comment period.

To access the document:

Go to the contractor's FTP site at: <ftp://205.158.69.157/>

User name: clients Password: welcometoendyna

In the EPA ORIA folder, you will find both Word and PDF versions -- I suggest you print from the Word version with 'View, Markup' turned OFF.

Attachments:

- A suggested re-organization for Chapter 6 that may improve readability
- Comment form
- Draft FR Notice of Availability (please provide any input you have, this is not subject to the 'showstoppers only' rule!)

Thank you for all your input and support on this project, and I look forward to hearing from all of you,

Sara D. DeCair, Health Physicist
www.epa.gov/radiation/rert/pags.htm
Center for Radiological Emergency Preparedness,
Prevention, and Response
U.S. Environmental Protection Agency
office (202) 343-9713
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[attachment "A suggested layout for Chapter 6.doc" deleted by Stuart Walker/DC/USEPA/US] [attachment
"Showstoppers Comment Form.doc" deleted by Stuart Walker/DC/USEPA/US] [attachment "FR Notice
draft 3-27-2007.doc" deleted by Stuart Walker/DC/USEPA/US]

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by OW/SF 1 x 10⁻⁴ Cancer Incidence Risk

Radionuclide	Concentrations in pCi/L				Comparison shows DRL is X times 10 ⁻⁴ or MCL value		
	DRLs with Rad Decay only	1x10 ⁻⁴ using OW Methods	MCLs	OW Risk Associated with MCL	1x10 ⁻⁴ using SF & 70yrs	Comparison of DRL to OW/SF 10 ⁻⁴	Comparison of DRL to MCL
Te-129	15,300,000,000	20,000	2,000	1x10 ⁻⁵		765,000	7,650,000
Te-127	712,000,000	2,970	900	3x10 ⁻⁵		239,731	791,111
Pm-151	54,100,000				453	119,426	
Te-131m	19,200,000		200		247	77,733	96,000
W-187	74,700,000	1,000	200	2x10 ⁻⁵		74,700	373,500
Np-239	24,900,000		300		397	62,720	83,000
Ce-143	30,400,000	500	100	2x10 ⁻⁵		60,800	304,000
La-140	13,800,000	300	60	2x10 ⁻⁵		46,000	230,000
Pm-149	21,300,000	500	100	2x10 ⁻⁵		42,600	213,000
Cs-134	11,300	0	80	3x10⁻²		42,375	141
Sb-127	7,280,000				202	36,040	
Au-198	16,900,000	500	100	2x10 ⁻⁵		33,800	169,000
Y-90	6,530,000	198	60	3x10 ⁻⁵		32,980	108,833
Bi-210	7,110,000	219	15			32,466	474,000
Te-132	3,780,000		90		120	31,500	42,000
Co-58	909,000	33	300	9x10 ⁻⁴		27,270	3,030
Mo-99	28,100,000	1,500	600	4x10 ⁻⁵		18,733	46,833
Sb-126	1,540,000				184	8,370	
Sn-125	1,580,000	198	60	3x10 ⁻⁵		7,980	26,333
Nd-147	3,940,000	500	200	4x10 ⁻⁵		7,880	19,700
Th-227	277,000	41	15			6,756	18,467
Ba-140	1,410,000	225	90	4x10 ⁻⁵		6,267	15,667
V-48	1,460,000				249	5,863	
P-32	1,370,000	300	30	1x10 ⁻⁵		4,567	45,667
Yb-169	2,060,000				510	4,039	
P-33	7,500,000				2,080	3,606	
I-131	267,000	75	3	4x10⁻⁶		3,560	89,000
Rb-86	892,000	300	600	2x10 ⁻⁴		2,973	1,487
Cs-136	1,160,000	400	800	2x10 ⁻⁴		2,900	1,450
Ce-141	2,030,000	750	300	4x10 ⁻⁵		2,707	6,767
Cr-51	43,700,000	19,800	6,000	3x10 ⁻⁵		2,207	7,283
Te-129m	468,000	225	90	4x10 ⁻⁵		2,080	5,200
Hf-181	984,000	500	200	4x10 ⁻⁵		1,968	4,920
Ru-103	1,620,000	1,000	200	2x10⁻⁵		1,620	8,100
In-114m	233,000	150	60	4x10 ⁻⁵		1,553	3,883
Y-91	341,000	225	90	4x10 ⁻⁵		1,516	3,789
Fe-59	591,000	400	200	5x10 ⁻⁵		1,478	2,955
Tb-160	415,000	330	100	3x10 ⁻⁵		1,258	4,150
Zr-95	773,000	660	200	3x10 ⁻⁵		1,171	3,865
Nb-95	2,260,000				1,940	1,165	
Sb-124	311,000	300	60	2x10 ⁻⁵		1,037	5,183
Tm-170	320,000	330	100	3x10 ⁻⁵		970	3,200
Ir-192	477,000	500	100	2x10⁻⁵		954	4,770

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by OW/SF 1 x 10⁻⁴ Cancer Incidence Risk

Radionuclide	Concentrations in pCi/L				Comparison shows DRL is X times 10 ⁻⁴ or MCL value		
	DRLs with Rad Decay only	1x10 ⁻⁴ using OW Methods	MCLs	OW Risk Associated with MCL	1x10 ⁻⁴ using SF & 70yrs	Comparison of DRL to OW/SF 10 ⁻⁴	Comparison of DRL to MCL
	Eu-154	94,300	99	60	6x10 ⁻⁵		953
I-132	3,780,000	4,500	90	2x10 ⁻⁶		840	42,000
Sn-113	620,000	750	300	4x10 ⁻⁵		827	2,067
Sc-46	397,000	500	100	2x10 ⁻⁵		794	3,970
Ge-68	216,000				293	737	
Pm-147	807,000		600		1,210	667	1,345
I-125	51,200				80	640	
Cm-242	31,200	51	15			612	2,080
Ta-182	297,000	500	100	2x10 ⁻⁵		594	2,970
Sn-123	201,000				340	591	
Se-75	170,000	300	900	3x10 ⁻⁴		567	189
Gd-153	1,070,000	1,980	600	3x10 ⁻⁵		540	1,783
Hg-203	529,000	990	60	6x10 ⁻⁴		534	8,817
Ru-106	36,500	75	30	4x10⁻⁵		487	1,217
Sn-126	38,700				80	484	
Ca-45	513,000	1,110	10	9x10 ⁻⁷		462	51,300
Pm-145	1,630,000				3,650	447	
Ce-144	43,300	99	30	3x10 ⁻⁵		437	1,443
Ba-133	125,000				300	417	
Ti-44	32,000				80	400	
Sm-151	1,890,000	5,000	1,000	2x10 ⁻⁵		378	1,890
Ho-166m	93,500				254	368	
Sr-89	363,000	1,000	20	2x10 ⁻⁶		363	18,150
K-40	30,000				83	361	
Ag-110m	106,000	297	90	3x10 ⁻⁵		357	1,178
Eu-155	607,000	1,980	600	3x10 ⁻⁵		307	1,012
Po-210	333	1	15			303	22
Co-60	57,600	200	100	5x10⁻⁵		288	576
Tl-204	170,000	600	300	5x10 ⁻⁵		283	567
Zn-65	75,400	300	300	1x10 ⁻⁴		251	251
Mn-54	375,000	1,500	300	2x10 ⁻⁵		250	1,250
Ni-63	1,220,000	5,000	50	1x10 ⁻⁶		244	24,400
Tc-99	288,000	1,260	900	7x10⁻⁵		229	320
Cl-36	199,000	875	700	8x10 ⁻⁵		227	284
Fe-55	631,000	2,800	2,000	7x10⁻⁵		225	316
Bi-207	147,000	660	200	3x10 ⁻⁵		223	735
Cd-109	120,000	600	600	1x10 ⁻⁴		200	200
Nb-94	106,000				613	173	
Sr-90	6,730	40	8	2x10⁻⁵		168	841
Na-22	66,100	400	400	1x10 ⁻⁴		165	165
C-14	319,000	2,000	2,000	1x10 ⁻⁴		160	160
Cs-137	13,800	100	200	2x10⁻⁴		138	69
U-235	3,960		65		29	137	61

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by OW/SF 1 x 10⁻⁴ Cancer Incidence Risk

Radionuclide	DRLs with Rad Decay only	Concentrations in pCi/L			OW Risk Associated with MCL	1x10 ⁻⁴ using SF & 70yrs	Comparison shows DRL is X times 10 ⁻⁴ or MCL value	
		1x10 ⁻⁴ using OW Methods	MCLs	Comparison of DRL to OW/SF 10 ⁻⁴			Comparison of DRL to MCL	
Pb-210	270					2	135	
Ra-226	659	5	5	1x10⁻⁴			132	132
U-238	4,150		10			32	130	415
S-35	731,000	6,250	500	8x10 ⁻⁶			117	1,462
Cd-113m	8,260					71	116	
Pu-236	2,400	26	15				92	160
H-3	4,540,000	50,000	20,000	4x10⁻⁵			91	227
Zr-93	167,000	2,200	2,000	9x10 ⁻⁵			76	84
I-129	1,750	25	1	4x10 ⁻⁶			70	1,750
Eu-152	139,000	2,000	200	1x10 ⁻⁵			70	695
Cm-244	1,530	23	15				67	102
Cm-243	1,260	21	15				60	84
Ac-227	585					10	59	
Cf-252	2,210	39	15				57	147
Np-237	1,730	32	15				54	115
Pu-238	815					16	51	
Pu-240	737					15	49	
Pu-239	737					15	49	
Pu-242	777					16	49	
Am-243	912	19	15				48	61
Am-241	908	19	15				48	61
Cm-246	894	19	15				47	60
Cm-245	890	19	15				47	59
Pu-241	39,900		300			1,160	34	133
Am-242m	971					29	33	
Pr-144	53,300					25,200	2	
Th-232	0	19	15				0	0
Th-228	0	18	15				0	0
Th-230	0	21	15				0	0
U-233	0		290,000			28	0	0
U-234	0		190,000			29	0	0
Pa-231	0	8	15				0	0
U-232	0		640,000,000			7	0	0
U-234	0	UMTRCA GW	30			29	0	0
Ba-137	13,800							
Rh-106	36,500							

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by MCL

Radionuclide	DRLs with Rad Decay only	Concentrations in pCi/L			OW Risk Associated with MCL	1x10 ⁻⁴ using SF & 70yrs	Comparison shows DRL is X times 10 ⁻⁴ or MCL value	
		1x10 ⁻⁴ using OW Methods	MCLs	Comparison of DRL to OW/SF 10 ⁻⁴			Comparison of DRL to MCL	
Te-129	*****	20,000	2,000	1x10 ⁻⁵			765,000	7,650,000
Te-127	712,000,000	2,970	900	3x10 ⁻⁵			239,731	791,111
Bi-210	7,110,000	219	15				32,466	474,000
W-187	74,700,000	1,000	200	2x10 ⁻⁵			74,700	373,500
Ce-143	30,400,000	500	100	2x10 ⁻⁵			60,800	304,000
La-140	13,800,000	300	60	2x10 ⁻⁵			46,000	230,000
Pm-149	21,300,000	500	100	2x10 ⁻⁵			42,600	213,000
Au-198	16,900,000	500	100	2x10 ⁻⁵			33,800	169,000
Y-90	6,530,000	198	60	3x10 ⁻⁵			32,980	108,833
Te-131m	19,200,000		200		247		77,733	96,000
I-131	267,000	75	3	4x10⁻⁶			3,560	89,000
Np-239	24,900,000		300		397		62,720	83,000
Ca-45	513,000	1,110	10	9x10 ⁻⁷			462	51,300
Mo-99	28,100,000	1,500	600	4x10 ⁻⁵			18,733	46,833
P-32	1,370,000	300	30	1x10 ⁻⁵			4,567	45,667
I-132	3,780,000	4,500	90	2x10 ⁻⁶			840	42,000
Te-132	3,780,000		90		120		31,500	42,000
Sn-125	1,580,000	198	60	3x10 ⁻⁵			7,980	26,333
Ni-63	1,220,000	5,000	50	1x10 ⁻⁶			244	24,400
Nd-147	3,940,000	500	200	4x10 ⁻⁵			7,880	19,700
Th-227	277,000	41	15				6,756	18,467
Sr-89	363,000	1,000	20	2x10 ⁻⁶			363	18,150
Ba-140	1,410,000	225	90	4x10 ⁻⁵			6,267	15,667
Hg-203	529,000	990	60	6x10 ⁻⁴			534	8,817
Ru-103	1,620,000	1,000	200	2x10⁻⁵			1,620	8,100
Cr-51	43,700,000	19,800	6,000	3x10 ⁻⁵			2,207	7,283
Ce-141	2,030,000	750	300	4x10 ⁻⁵			2,707	6,767
Te-129m	468,000	225	90	4x10 ⁻⁵			2,080	5,200
Sb-124	311,000	300	60	2x10 ⁻⁵			1,037	5,183
Hf-181	984,000	500	200	4x10 ⁻⁵			1,968	4,920
Ir-192	477,000	500	100	2x10⁻⁵			954	4,770
Tb-160	415,000	330	100	3x10 ⁻⁵			1,258	4,150
Sc-46	397,000	500	100	2x10 ⁻⁵			794	3,970
In-114m	233,000	150	60	4x10 ⁻⁵			1,553	3,883
Zr-95	773,000	660	200	3x10 ⁻⁵			1,171	3,865
Y-91	341,000	225	90	4x10 ⁻⁵			1,516	3,789
Tm-170	320,000	330	100	3x10 ⁻⁵			970	3,200
Co-58	909,000	33	300	9x10 ⁻⁴			27,270	3,030
Ta-182	297,000	500	100	2x10 ⁻⁵			594	2,970
Fe-59	591,000	400	200	5x10 ⁻⁵			1,478	2,955
Cm-242	31,200	51	15				612	2,080
Sn-113	620,000	750	300	4x10 ⁻⁵			827	2,067
Sm-151	1,890,000	5,000	1,000	2x10 ⁻⁵			378	1,890
Gd-153	1,070,000	1,980	600	3x10 ⁻⁵			540	1,783
I-129	1,750	25	1	4x10 ⁻⁶			70	1,750
Eu-154	94,300	99	60	6x10 ⁻⁵			953	1,572

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by MCL

Radionuclide	DRLs with Rad Decay only	Concentrations in pCi/L			OW Risk Associated with MCL	Comparison shows DRL is X times 10 ⁻⁴ or MCL value	
		1x10 ⁻⁴ using OW Methods	MCLs	1x10 ⁻⁴ using SF & 70yrs		Comparison of DRL to OW/SF 10 ⁻⁴	Comparison of DRL to MCL
Rb-86	892,000	300	600	2x10 ⁻⁴		2,973	1,487
S-35	731,000	6,250	500	8x10 ⁻⁶		117	1,462
Cs-136	1,160,000	400	800	2x10 ⁻⁴		2,900	1,450
Ce-144	43,300	99	30	3x10 ⁻⁵		437	1,443
Pm-147	807,000		600		1,210	667	1,345
Mn-54	375,000	1,500	300	2x10 ⁻⁵		250	1,250
Ru-106	36,500	75	30	4x10⁻⁵		487	1,217
Ag-110m	106,000	297	90	3x10 ⁻⁵		357	1,178
Eu-155	607,000	1,980	600	3x10 ⁻⁵		307	1,012
Sr-90	6,730	40	8	2x10⁻⁵		168	841
Bi-207	147,000	660	200	3x10 ⁻⁵		223	735
Eu-152	139,000	2,000	200	1x10 ⁻⁵		70	695
Co-60	57,600	200	100	5x10⁻⁵		288	576
Tl-204	170,000	600	300	5x10 ⁻⁵		283	567
U-238	4,150		10		32	130	415
Tc-99	288,000	1,260	900	7x10⁻⁵		229	320
Fe-55	631,000	2,800	2,000	7x10⁻⁵		225	316
Cl-36	199,000	875	700	8x10 ⁻⁵		227	284
Zn-65	75,400	300	300	1x10 ⁻⁴		251	251
H-3	4,540,000	50,000	20,000	4x10⁻⁵		91	227
Cd-109	120,000	600	600	1x10 ⁻⁴		200	200
Se-75	170,000	300	900	3x10 ⁻⁴		567	189
Na-22	66,100	400	400	1x10 ⁻⁴		165	165
Pu-236	2,400	26	15			92	160
C-14	319,000	2,000	2,000	1x10 ⁻⁴		160	160
Cf-252	2,210	39	15			57	147
Cs-134	11,300	0	80	3x10⁻²		42,375	141
Pu-241	39,900		300		1,160	34	133
Ra-226	659	5	5	1x10⁻⁴		132	132
Np-237	1,730	32	15			54	115
Cm-244	1,530	23	15			67	102
Cm-243	1,260	21	15			60	84
Zr-93	167,000	2,200	2,000	9x10 ⁻⁵		76	84
Cs-137	13,800	100	200	2x10⁻⁴		138	69
U-235	3,960		65		29	137	61
Am-243	912	19	15			48	61
Am-241	908	19	15			48	61
Cm-246	894	19	15			47	60
Cm-245	890	19	15			47	59
Po-210	333	1	15			303	22
Th-228	0	18	15			0	0
U-233	0		290,000		28	0	0
Th-232	0	19	15			0	0
Pa-231	0	8	15			0	0
U-232	0		640,000,000		7	0	0
U-234	0		190,000		29	0	0

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by MCL

Radionuclide	DRLs with Rad Decay only	Concentrations in pCi/L		OW Risk Associated with MCL	1x10 ⁻⁴ using SF & 70yrs	Comparison shows DRL is X times 10 ⁻⁴ or MCL value	
		1x10 ⁻⁴ using OW Methods	MCLs			Comparison of DRL to OW/SF 10-4	Comparison of DRL to MCL
Th-230	0	21	15			0	0
U-234	0	UMTRCA GW	30		29	0	0
Ti-44	32,000				80	400	
K-40	30,000				83	361	
V-48	1,460,000				249	5,863	
Pu-238	815				16	51	
Pu-240	737				15	49	
Pu-242	777				16	49	
Am-242m	971				29	33	
P-33	7,500,000				2,080	3,606	
Pu-239	737				15	49	
Pm-151	54,100,000				453	119,426	
Pm-145	1,630,000				3,650	447	
Sb-126	1,540,000				184	8,370	
Pr-144	53,300				25,200	2	
Ba-137	13,800						
Ho-166m	93,500				254	368	
I-125	51,200				80	640	
Yb-169	2,060,000				510	4,039	
Sb-127	7,280,000				202	36,040	
Sn-123	201,000				340	591	
Sn-126	38,700				80	484	
Ge-68	216,000				293	737	
Cd-113m	8,260				71	116	
Rh-106	36,500						
Nb-95	2,260,000				1,940	1,165	
Pb-210	270				2	135	
Nb-94	106,000				613	173	
Ac-227	585				10	59	
Ba-133	125,000				300	417	

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1×10^{-4} Concentrations

Sorted by Radionuclide

Radionuclide	DRLs with Rad Decay only	Concentrations in pCi/L			OW Risk Associated with MCL	1x10-4 using SF & 70yrs	Comparison shows DRL is X times 10-4 or MCL value	
		1x10-4 using OW Methods	MCLs	Comparison of DRL to OW/SF 10-4			Comparison of DRL to MCL	
H-3	4,540,000	50,000	20,000	4x10-5			91	227
C-14	319,000	2,000	2,000	1x10-4			160	160
Na-22	66,100	400	400	1x10-4			165	165
P-32	1,370,000	300	30	1x10-5			4,567	45,667
P-33	7,500,000				2,080		3,606	
S-35	731,000	6,250	500	8x10-6			117	1,462
Cl-36	199,000	875	700	8x10-5			227	284
K-40	30,000				83		361	
Ca-45	513,000	1,110	10	9x10-7			462	51,300
Sc-46	397,000	500	100	2x10-5			794	3,970
Ti-44	32,000				80		400	
V-48	1,460,000				249		5,863	
Cr-51	43,700,000	19,800	6,000	3x10-5			2,207	7,283
Mn-54	375,000	1,500	300	2x10-5			250	1,250
Fe-55	631,000	2,800	2,000	7x10-5			225	316
Fe-59	591,000	400	200	5x10-5			1,478	2,955
Co-58	909,000	33	300	9x10-4			27,270	3,030
Co-60	57,600	200	100	5x10-5			288	576
Ni-63	1,220,000	5,000	50	1x10-6			244	24,400
Zn-65	75,400	300	300	1x10-4			251	251
Ge-68	216,000				293		737	
Se-75	170,000	300	900	3x10-4			567	189
Rb-86	892,000	300	600	2x10-4			2,973	1,487
Sr-89	363,000	1,000	20	2x10-6			363	18,150
Sr-90	6,730	40	8	2x10-5			168	841
Y-90	6,530,000	198	60	3x10-5			32,980	108,833
Y-91	341,000	225	90	4x10-5			1,516	3,789
Zr-93	167,000	2,200	2,000	9x10-5			76	84
Zr-95	773,000	660	200	3x10-5			1,171	3,865
Nb-94	106,000				613		173	
Nb-95	2,260,000				1,940		1,165	
Mo-99	28,100,000	1,500	600	4x10-5			18,733	46,833
Tc-99	288,000	1,260	900	7x10-5			229	320
Ru-103	1,620,000	1,000	200	2x10-5			1,620	8,100
Ru-106	36,500	75	30	4x10-5			487	1,217
Rh-106	36,500							
Ag-110m	106,000	297	90	3x10-5			357	1,178
Cd-109	120,000	600	600	1x10-4			200	200
Cd-113m	8,260				71		116	
In-114m	233,000	150	60	4x10-5			1,553	3,883
Sn-113	620,000	750	300	4x10-5			827	2,067
Sn-123	201,000				340		591	
Sn-125	1,580,000	198	60	3x10-5			7,980	26,333
Sn-126	38,700				80		484	
Sb-124	311,000	300	60	2x10-5			1,037	5,183
Sb-126	1,540,000				184		8,370	

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by Radionuclide

Radionuclide	DRLs with Rad Decay only	Concentrations in pCi/L			OW Risk Associated with MCL	Comparison shows DRL is X times 10 ⁻⁴ or MCL value	
		1x10 ⁻⁴ using OW Methods	MCLs	1x10 ⁻⁴ using SF & 70yrs		Comparison of DRL to OW/SF 10 ⁻⁴	Comparison of DRL to MCL
Sb-127	7,280,000					202	36,040
Te-127	712,000,000	2,970	900	3x10 ⁻⁵			239,731
Te-129	*****	20,000	2,000	1x10 ⁻⁵			765,000
Te-129m	468,000	225	90	4x10 ⁻⁵			2,080
Te-131m	19,200,000		200			247	77,733
Te-132	3,780,000		90			120	31,500
I-132	3,780,000	4,500	90	2x10 ⁻⁶			840
I-125	51,200					80	640
I-129	1,750	25	1	4x10 ⁻⁶			70
I-131	267,000	75	3	4x10⁻⁶			3,560
Cs-134	11,300	0	80	3x10⁻²			42,375
Cs-136	1,160,000	400	800	2x10 ⁻⁴			2,900
Cs-137	13,800	100	200	2x10⁻⁴			138
Ba-137	13,800						
Ba-133	125,000					300	417
Ba-140	1,410,000	225	90	4x10 ⁻⁵			6,267
La-140	13,800,000	300	60	2x10 ⁻⁵			46,000
Ce-141	2,030,000	750	300	4x10 ⁻⁵			2,707
Ce-143	30,400,000	500	100	2x10 ⁻⁵			60,800
Ce-144	43,300	99	30	3x10 ⁻⁵			437
Pr-144	53,300					25,200	2
Nd-147	3,940,000	500	200	4x10 ⁻⁵			7,880
Pm-145	1,630,000					3,650	447
Pm-147	807,000		600			1,210	667
Pm-149	21,300,000	500	100	2x10 ⁻⁵			42,600
Pm-151	54,100,000					453	119,426
Sm-151	1,890,000	5,000	1,000	2x10 ⁻⁵			378
Eu-152	139,000	2,000	200	1x10 ⁻⁵			70
Eu-154	94,300	99	60	6x10 ⁻⁵			953
Eu-155	607,000	1,980	600	3x10 ⁻⁵			307
Gd-153	1,070,000	1,980	600	3x10 ⁻⁵			540
Tb-160	415,000	330	100	3x10 ⁻⁵			1,258
Ho-166m	93,500					254	368
Tm-170	320,000	330	100	3x10 ⁻⁵			970
Yb-169	2,060,000					510	4,039
Hf-181	984,000	500	200	4x10 ⁻⁵			1,968
Ta-182	297,000	500	100	2x10 ⁻⁵			594
W-187	74,700,000	1,000	200	2x10 ⁻⁵			74,700
Ir-192	477,000	500	100	2x10⁻⁵			954
Au-198	16,900,000	500	100	2x10 ⁻⁵			33,800
Hg-203	529,000	990	60	6x10 ⁻⁴			534
Tl-204	170,000	600	300	5x10 ⁻⁵			283
Pb-210	270					2	135
Bi-207	147,000	660	200	3x10 ⁻⁵			223
Bi-210	7,110,000	219	15				32,466
Po-210	333	1	15				303

Table Comparing 500 mrem/yr DRL Concentrations to MCL or 1 x 10⁻⁴ Concentrations

Sorted by Radionuclide

Radionuclide	DRLs with Rad Decay only	Concentrations in pCi/L		OW Risk Associated with MCL	1x10 ⁻⁴ using SF & 70yrs	Comparison shows DRL is X times 10 ⁻⁴ or MCL value	
		1x10 ⁻⁴ using OW Methods	MCLs			Comparison of DRL to OW/SF 10 ⁻⁴	Comparison of DRL to MCL
Ra-226	659	5	5	1x10⁻⁴		132	132
Ac-227	585				10	59	
Th-227	277,000	41	15			6,756	18,467
Th-228	0	18	15			0	0
Th-230	0	21	15			0	0
Th-232	0	19	15			0	0
Pa-231	0	8	15			0	0
U-232	0		640,000,000		7	0	0
U-233	0		290,000		28	0	0
U-234	0		190,000		29	0	0
U-234	0	UMTRCA GW	30		29	0	0
U-235	3,960		65		29	137	61
U-238	4,150		10		32	130	415
Np-237	1,730	32	15			54	115
Np-239	24,900,000		300		397	62,720	83,000
Pu-236	2,400	26	15			92	160
Pu-238	815				16	51	
Pu-239	737				15	49	
Pu-240	737				15	49	
Pu-241	39,900		300		1,160	34	133
Pu-242	777				16	49	
Am-241	908	19	15			48	61
Am-242m	971				29	33	
Am-243	912	19	15			48	61
Cm-242	31,200	51	15			612	2,080
Cm-243	1,260	21	15			60	84
Cm-244	1,530	23	15			67	102
Cm-245	890	19	15			47	59
Cm-246	894	19	15			47	60
Cf-252	2,210	39	15			57	147